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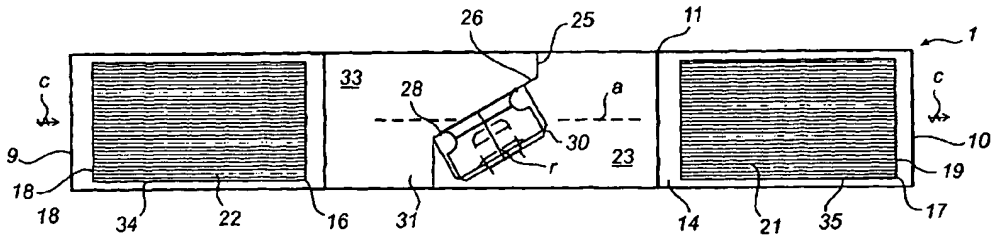
(54) Title: HEAT EXCHANGER FOR A CLOSED COMPARTMENT



(57) Abstract: A heat exchanger (1) for a closed compartment, such as the compartment in a cubicle, comprises a heat exchanger element (16, 17) of heat-conducting metal sheet (18, 19) which forms longitudinal ducts communicating with the ambient air, and transverse ducts (21, 22) communicating with the compartment. A first fan means is mounted in the compartment to feed hot air from the compartment through the transverse ducts (21, 22). A second fan means (30) is separated from the compartment and arranged to feed ambient air through the longitudinal ducts for the purpose of carrying off heat transferred from the hot air in the compartment via the metal sheet (18, 19), to the ambient air and thus cooling the compartment. The heat exchanger element is divided into a first unit (16) arranged in an inlet end of an air duct communicating with the ambient air and the longitudinal ducts, and a second unit (17) arranged in an outlet end of the air duct, and the second fan means (30) is arranged in the air duct between the first and second units (16, 17).

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HEAT EXCHANGER FOR A CLOSED COMPARTMENT

Field of the Invention

The present invention relates to a heat exchanger for a closed compartment, such as the compartment in a cubicle for a telephone base station, in which heat-producing equipment in the form of electrical components is arranged, said heat exchanger comprising a heat exchanger element of heat-conducting metal sheet which forms longitudinal ducts communicating with the ambient air, and transverse ducts communicating with the compartment, a first fan means which is mounted in the compartment and arranged to feed hot air from the compartment through the transverse ducts, and a second fan means which is separated from the compartment and arranged to feed ambient air through the longitudinal ducts for the purpose of carrying off heat transferred from the hot air in the compartment via the metal sheet, to the ambient air and thus cooling the compartment.

Background Art

A heat exchanger as described above is known from US-A-5,054,545. In the known heat exchanger, the second fan means arranged outside the compartment consists of two axial fans which are each arranged at one end of a tubular air duct, along which the longitudinal ducts extend. The location at one end each of the air duct certainly contributes to reducing the risk of a short circuit between the airflows into and out of the air duct, but the vulnerable location of the fans causes difficulties with noise suppression in densely built-up areas and unfavourable temperature influence on the fans, such as extreme cold influence in cold climates on the fans in the inlet of the air duct and extreme heat influence by the hot air inside the compartment on the fans in the outlet of the air duct.

Object of the Invention

Therefore, the object of the invention is to provide a heat exchanger according to the preamble, in which the noise caused by the second fan means is well suppressed and in which the second fan means is allowed to operate in an environment which is better protected from cold and heat.

Summary of the Invention

According to the invention, this is achieved in a heat exchanger according to the preamble by the heat exchanger element being divided into a first unit arranged in an inlet end of an air duct communicating with the longitudinal ducts, and a second unit arranged in an outlet end of the air duct, and by the second fan means being arranged in the air duct between said first and second units.

By mounting according to the invention the second fan means between a first heat exchanger unit, in which part of the heat from the hot air inside the compartment is transferred to the ambient air in the air duct, and a second heat exchanger unit, in which a further part of the heat from the hot air inside the compartment is transferred to the ambient air in the air duct, the noise from the second fan means is efficiently suppressed by the two heat exchanger units, and the ambient air, after passing the first heat exchanger unit, keeps a temperature which is neither too low nor too high to jeopardise long term operation of the fan means.

Preferably, in a heat exchanger according to the invention the longitudinal ducts are parallel to a centre plane through the air duct, and the second fan means comprises at least one radial fan, which is mounted in a hole in an interior wall extending transversely of the chamber and having a central portion inclined to said centre plane, and which has an axis of rotation arranged at right angles to said central portion.

By using a central portion inclined to said centre plane and a correspondingly inclined radial fan, it will be possible to arrange a service door in the wall of the air duct, through which door the fan will be conveniently accessible for service or exchange, the angle of inclination of the central portion to said centre plane suitably being in the range 15-45°, preferably 25-35°.

Preferably, the second fan means comprises two radial fans, and the chamber upstream thereof is divided, by means of a partition connected to the interior wall, into a first duct from the first unit to the first of the two fans and a second duct from the first unit to the second of the two fans.

This solution results in great operational reliability since it is only on rare occasions that two fans break down at the same time and since the partition prevents short circuit of the air flow if one of the fans should stop.

Preferably, in the heat exchanger according to the invention the transverse ducts of the first unit open at opposing first lateral openings of a heat exchanger casing, and the transverse ducts of the second unit open at opposing second lateral openings of the heat exchanger casing, a centre axis through the two first and the two second lateral openings being parallel to the centre plane of the air duct.

The advantage of this solution is that the heat exchanger can thus be designed as a very low unit which is suitable to be hidden away under a roof, for example in a cubicle for a telephone base station.

Preferably, the first fan means comprises one fan each for the first and the second unit of the heat exchanger element.

The advantage of the solution is that it allows a maximum degree of efficiency for each heat exchanger element to be achieved.

Preferably, the fan of the first unit is an axial fan which is mounted in one of the first lateral openings, and the fan of the second unit is an axial fan which is mounted in one of the second lateral openings.

The advantage of this is that the axial fans make it possible to obtain a simple as well as compact construction.

Brief Description of the Drawings

A preferred embodiment of the heat exchanger according to the invention will now be described in more detail with reference to the accompanying drawings in which

Fig. 1 is a front view of the heat exchanger with a broken-away wall portion;

Fig. 2 is a bottom view of the heat exchanger with a broken-away wall portion;

Fig. 3 is a rear view of the heat exchanger with a broken-away wall portion;

Fig. 4 is an end view of the heat exchanger; and

Fig. 5 is a front view of a cubicle and the heat exchanger with some wall portions broken away.

Description of a Preferred Embodiment

The heat exchanger illustrated in the drawings and designated 1 is intended for cooling of closed compartments, such as the compartment 2 in the cubicle 3 in Fig. 5. Such cubicles are commonly used in connection with base stations for mobile telephone networks and are then mounted outdoors where they are thus subjected to direct climate influence. A typical condition of such cubicles is that the compartment in the same must be easily accessible to allow easy maintenance of electronic components and the like mounted therein. In order to facilitate this, the heat exchanger 1 according to the preferred embodiment of the invention is designed, as is evident from Fig. 5, so as to be mountable immediately under the roof 4 of the cubicle 3 in a rarely utilised rear part of the compartment 2, in which part the cubicle 1 in two opposing side walls 5, 6 has openings 7 and 8

for an outdoor air inlet 9 and an outdoor air outlet 10 of the heat exchanger 1.

The actual heat exchanger 1 comprises, as is evident from Figs 1-4, a right-angled parallelepipedic casing 11, which is defined by an elongate front wall 12 (see especially Fig. 1), a lower wall 13 (see especially Fig. 2), which is approximately twice as wide as the front wall 12, an elongate rear wall 14 (see especially Fig. 3), an upper wall (not shown) corresponding to the lower wall 13 and two opposite end walls, of which the end wall 15 is shown in Fig. 4.

Inside the casing there is a heat exchanger element, which is divided into a first and a second right-angled parallelepipedic unit 16 and 17. Both consist of a plurality of stacked heat-conducting metal sheets 18, 19 forming longitudinal ducts 20, which are parallel to a centre plane a which is parallel to the lower wall 13 of the heat exchanger 1 and extends in the longitudinal direction of the heat exchanger 1, and, positioned between these, transverse ducts 21, 22 which are parallel to the centre plane a and extend in the transverse direction b of the heat exchanger 1.

The casing 11 comprises between the units 16, 17 a chamber 23 which is centrally divided by an interior wall 25 which extends between the front and rear wall 12, 14 and the upper and lower wall 13 of the casing 11. The interior wall 25 has a central portion 26 which is inclined to said centre plane a at an angle of inclination v of about 30° and in which two circular holes 27, 28 are formed. A radial fan 29, 30 is located in each hole 27, 28 to introduce outdoor air through the longitudinal ducts 20 of the first unit 16 and then blow this air through the longitudinal ducts of the second unit 17.

To this end, the casing 11 has in its first end wall 15 an above-mentioned outdoor air inlet 9 and in its opposing second end wall an outdoor air outlet 10 which has also been mentioned above. The inlet and outlet 9, 10

thus define, together with said longitudinal ducts 20, the chamber 23 and holes 27, 28 in the interior wall 25 an outdoor air duct which extends through the entire heat exchanger 1 and whose direction of flow is indicated by arrows c.

To prevent, in case of breakdown of one of the fans 29, 30, short circuit of the air flow produced by the remaining fan 29, 30, a partition 31 is arranged upstream of the fans 29, 30. The partition 31 is connected to the interior wall 25 and extends all the way to the first unit 16 and thus divides the upstream part of the chamber 23 into a first and a second lateral duct 32, 33.

In a addition to the outdoor air inlet and outlet 9, 10, the casing 11 has in its rear wall 14 just in front of the units 16, 17 an indoor air inlet 34, 35 each, communicating with the transverse ducts 21, 22 of each unit 16, 17. Moreover the casing 11 has in its front wall 12 just in front of the units 16, 17 an indoor air outlet 36, 37 each, also communicating with the transverse ducts 19 of each unit 16, 17 and, together with the indoor air inlets 34, 35, each defining a centre axis b, which is identical to the above-mentioned transverse direction. In each indoor air outlet 34, 35, an axial fan 38, 39 is mounted, which is arranged to introduce heated air from the compartment 2 through the transverse ducts 21, 22 of the two units 15, 16 in order to cool this air by heat exchange with the outdoor air in the longitudinal ducts 20 by way of the heat-conducting metal sheets 18, 19 of the units 16, 17.

The advantage of the embodiment described above and other conceivable embodiments of the invention according to the definition in the claims is that the fans 29, 30 are well protected in the chamber 23, thereby providing good noise suppression and increasing the service life of the fans owing to the fact that they are not directly exposed to climatic stresses.

CLAIMS

1. A heat exchanger for a closed compartment (2), such as the compartment in a cubicle (3) for a telephone base station, in which heat-producing equipment in the form of electrical components is arranged, said heat exchanger comprising a heat exchanger element (16, 17) of heat-conducting metal sheet (18, 19) which forms longitudinal ducts (20) communicating with the ambient air, and transverse ducts (21, 22) communicating with the compartment (2), a first fan means (38, 39) which is mounted in the compartment (2) and arranged to feed hot air from the compartment (2) through the transverse ducts (21, 22), and a second fan means (29, 30) which is separated from the compartment (2) and arranged to feed ambient air through the longitudinal ducts (20) for the purpose of carrying off heat transferred from the hot air in the compartment (2) via the metal sheet (18, 19), to the ambient air and thus cooling the compartment (2), c h a r a c t e r i s e d in that the heat exchanger element is divided into a first unit (16) arranged in an inlet end of an air duct communicating with the ambient air and the longitudinal ducts (20), and a second unit (17) arranged in an outlet end of the air duct, and that the second fan means (29, 30) is arranged in the air duct between said first and second units (16, 17).

2. A heat exchanger as claimed in claim 1, c h a r a c t e r i s e d in that the longitudinal ducts (20) are parallel to the centre plane (a) through the air duct, and that the second fan means comprises at least one radial fan (29, 30), which is mounted in a hole (27, 28) in an interior wall (25) extending transversely of a chamber (23) and having a central portion (26) inclined to said centre plane (a), and which has an axis of rotation (r) arranged at right angles to said central portion (26).

3. A heat exchanger as claimed in claim 2, c h a r a c t e r i s e d in that the angle of inclination (v) of the central portion (26) to said centre plane (a) is in the range 15-45°, preferably 25-35°.

4. A heat exchanger as claimed in claim 2 or 3, c h a r a c t e r i s e d in that the second fan means comprises two radial fans (29, 30), and that the chamber (23) upstream thereof is divided, by means of a partition (31) connected to the interior wall (25), into a first duct (32) from the first unit (16) to the first (29) of the two fans and a second duct (33) from the first unit (16) to the second (30) of the two fans.

5. A heat exchanger as claimed in any one of claims 1-4, c h a r a c t e r i s e d in that the transverse ducts (21) of the first unit (16) open at opposing first lateral openings (34, 36) of a heat exchanger casing (11), and that the transverse ducts (22) of the second unit (17) open at opposing second lateral openings (35, 37) of the heat exchanger casing (11), a centre axis (b) through the two first and the two second lateral openings being parallel to the centre plane (a) of the air duct.

6. A heat exchanger as claimed in claim 5, c h a r a c t e r i s e d in that the first fan means comprises one fan each (38, 39) for the first and the second unit (16, 17) of the heat exchanger element.

7. A heat exchanger as claimed in claim 6, c h a r a c t e r i s e d in that the fan of the first unit (16) is an axial fan (38) which is mounted in one of the first lateral openings (34, 36), and that the fan of the second unit is an axial fan (39) which is mounted in one of the second lateral openings (35, 37).

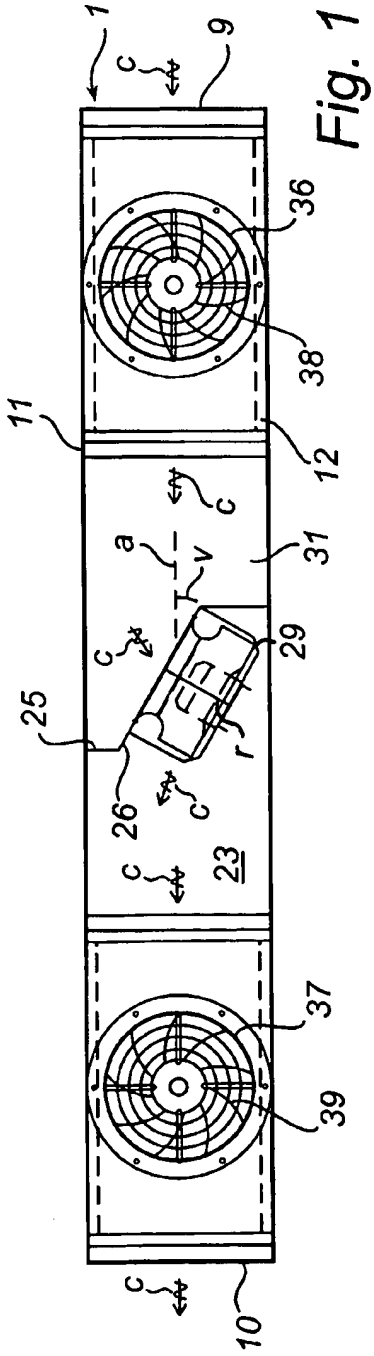
1
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Fig. 1

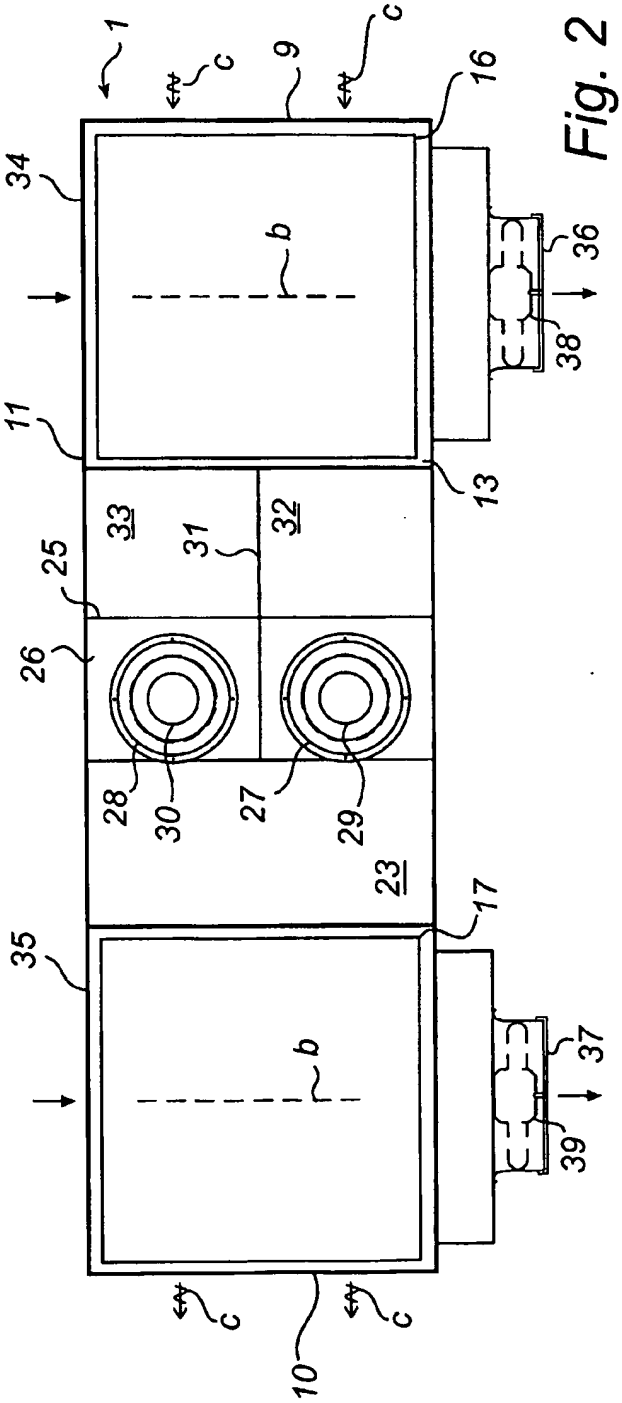
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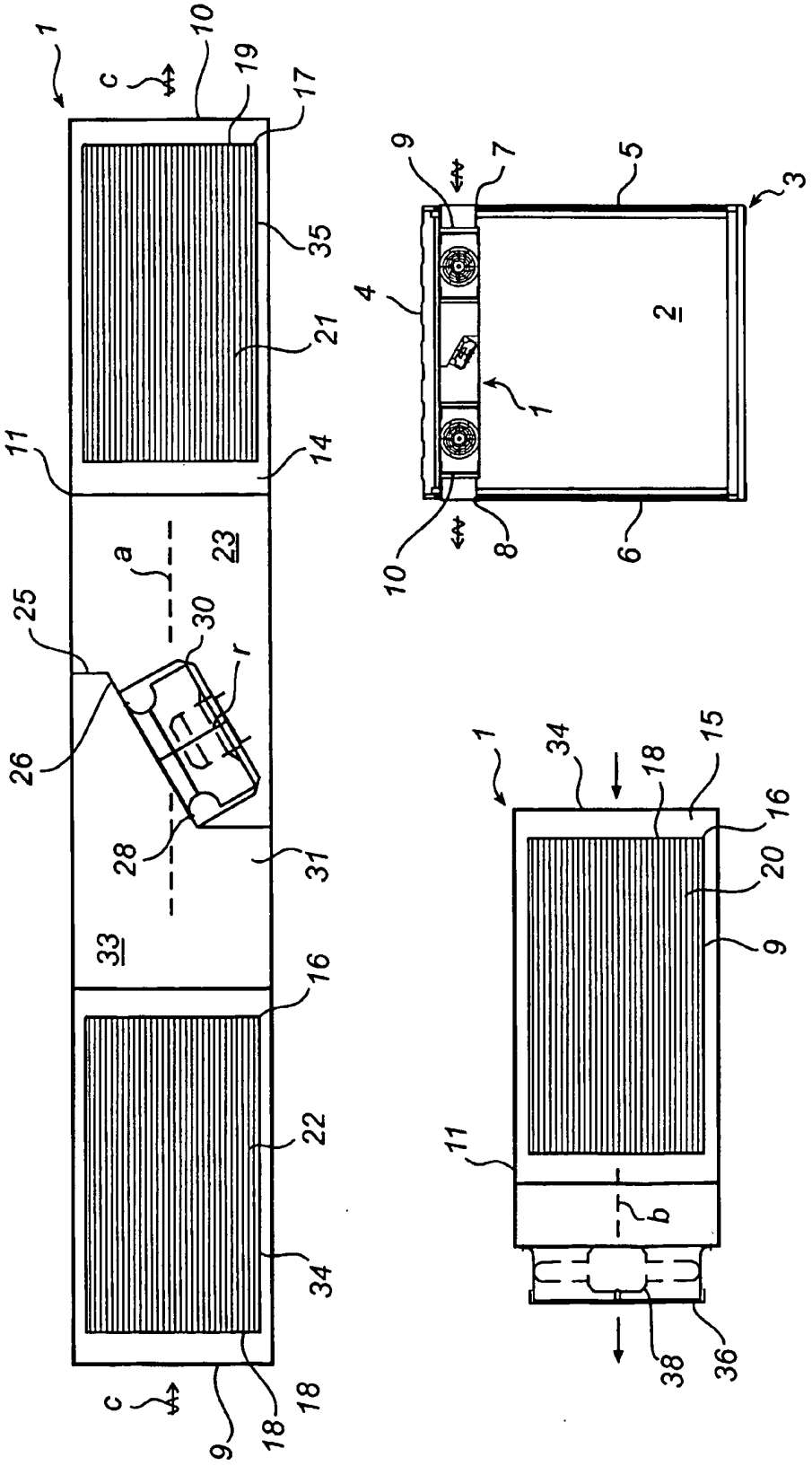
Fig. 2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18
c
9
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1
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6
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34
18
15
16
20
9
11
b
38
36

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 02/00209

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H05K 7/20, F28F 3/02
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H05K, F28F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6039111 A (KAWAGUCHI ET AL), 21 March 2000 (21.03.00) --	1-7
A	US 6024165 A (MELANE ET AL), 15 February 2000 (15.02.00) --	1-7
A	US 5603376 A (HENDRIX), 18 February 1997 (18.02.97) --	1-7
A	US 5054545 A (GHAEMIAN), 8 October 1991 (08.10.91) --	1-7

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
17 April 2002	02 -05- 2002
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Per-Olof Warnbo / JA A Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 02/00209

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4807441 A (AGEE ET AL), 28 February 1898 (28.02.98) -- --------	1-7

INTERNATIONAL SEARCH REPORT

Information on patent family members

28/01/02

International application No.
PCT/SE 02/00209

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